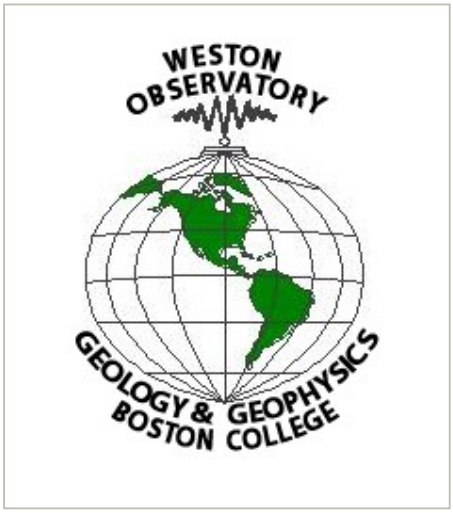
A STUDY OF NEW ENGLAND SEISMICITY

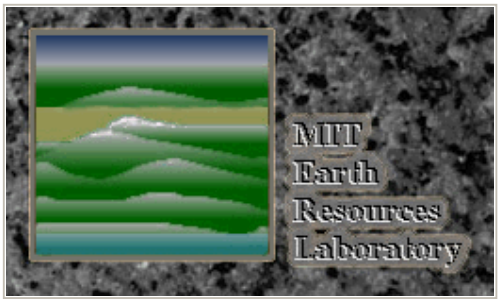
Quarterly Earthquake Report

October - December, 2002

New England

Seismic Network





Weston Observatory

381 Concord Road

Weston, MA 02493

Earth Resources Lab

Massachusetts Institute of Technology

42 Carleton Street

Cambridge, MA 02142

NEW ENGLAND SEISMIC NETWORK

John E. Ebel, Principal Investigator	M. Nafi Toksöz, Principal Investigator
Weston Observatory	Earth Resources Lab
Dept. of Geology and Geophysics	Dept. of Earth, Atmospheric, and Planetary Sciences
Boston College	Massachusetts Institute of Technology
381 Concord Road	42 Carleton Street
Weston, MA 02493	Cambridge, MA 02142
Email: ebel@bc.edu	Email: toksoz@mit.edu
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Prepared by Anastasia Macherides Moulis

Email: weston.observatory@bc.edu

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905 National Center

12201 Sunrise Valley Drive

Reston, Virginia 20192

Notice

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Introduction

The New England Seismic Network (NESN) is operated collaboratively by the Weston Observatory (WES) of Boston College and the Earth Resources Lab (ERL) of the Massachusetts Institute of Technology. The mission of the NESN is to operate and maintain a regional seismic network with digital recording of seismic ground motions for the following purposes: 1) to determine the location and magnitude of earthquakes in and adjacent to New England and report felt events to public safety agencies, 2) to define the crust and upper mantle structure of the northeastern United States, 3) to derive the source parameters of New England earthquakes, and 4) to estimate the seismic hazard in the area.

This report summarizes the work of the NESN for the period October - December, 2002. It includes a brief summary of the network's equipment and operation, and a short discussion of data management procedures. A list of participating personnel is given in Table 1. There were 2 earthquakes that occurred within or near the network during this reporting period. Phase information for these earthquakes is included in this report.

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Current Network Operation and Status

The New England Seismic Network currently consists of 14 broadband three-component, 4 short-period vertical, and 8 strong-motion stations. The coordinates of the stations are given in Table 2, and maps of the weak- and strong-motion networks are shown in Figures 1 and 2, respectively.

WES now operates 13 stations with broadband instruments consisting of Guralp CMG-40T three-component sensors. Ground motions recorded by these sensors aredigitized at 100 sps with 16-bit resolution. Additional gain-ranging provides 126 dB dynamic range. These stations are operated in dialup mode with waveform segments of suspected events transmitted in digital mode to Weston Observatory for analysis and archiving. During the year 2001, two new seismic stations were added to the WES network. Station UMM was placed in northeastern Maine and station FFD was placed in central New Hamp shire. Station MIM, in central Maine was dismantled. WES also maintains 8 SMA-1 strong-motion instruments in New England.

ERL at MIT currently operates 4 short-period stations, all located within 100 km of Boston. The short- period instruments have 1.0 Hz L4C vertical seismometers. Data recorded by these seismometers is transmitted continuously in analog mode to ERL and digitized (12-bit) into a PC at 50 sps. A data acquisition program on the PCtriggers on events detected in the short-period data streams and saves them toa disk for manual analysis. Station WFM also has a new three-component, high dynamic range instrumen t. The instrument has a CMG-40T sensor and transmits 3-channel, 24-bit data at 100 sps continuously to a central processor (Pentium PC) at ERL. Waveform windows of suspected events are extracted from the data stream, analyzed and archived with the short-period data. WES and ERL record some stations in analog format on helicorders to provide additional data for analysis.

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Seismicity

There were 2 earthquakes that occurred in or adjacent to the NESN during this reporting period. A summary of the location data is given in Table 3. Figure 3 shows the locations of these events. Figure 4 shows the locations of all events since the beginning of network operation in October, 1975.

Table 4 gives the station phase data and detailed hypocenter data for each event listed in Table 3. In addition to NESN data, arrival time and magnitude data sometimes are contributed for seismic stations operated by the Geological Survey of Canada (GSC), the Lamont-Doherty Cooperative Seismographic Network., and the US National Seismic Network. Final locations for this section were computed using the program HYPO78. For regional events (those too far from the NESN to obtain accurate locations and magnitudes) phase data are given for NESN stations, but the entry in Table 3 lists the hypocenter and geographic location information adopted from the authoritative network. Accordingly, the epicenter is plotted on the maps using the entry from Table 3.

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Data Management

Recent event locations are available via FTP at: SEISMOEAGLE.BC.EDU. Waveform data are saved in Nanometrics, ASCII, and SEED formats and are available via SEISMOEAGLE.BC.EDU or through personal contact. Earthquake lists can be fingered at QUAKE@SEISMOEAGLE.BC.EDU. Weston Observatory maintains two web pages with information about local earthquakes: "http://www.bc.edu:80/bc_org/avp/cas/wesobs/" and "http://seismoeagle.bc.edu/". The latter page is still under contruction. Currently available on the seismoeagle web page is the full catalog of northeastern U.S. earthquake activity to 1992. This will be updated as new Northeastern U.S. Seismic Network Bulletins are produced.

MIT/ERL provides two internet utilities, the MIT/ERL web-site("www-erl.mit.edu/NESN/homepage.html") and an anonymousFTP directory, to distribute seismic data. SESAME (Seismic Event Server atMIT/ERL) is the web data server that distributescatalogs, rep orts, earthquake bulletins, and epicenter and station maps(including an archive of recent seismic events). The FTP site, named "sunda.mit.edu", is the current facility available to download waveform data recorded by the MIT NESN. The client machine IP nu mber must be forwarded to us for the client to gain access to the anonymous FTP directory. After logging on, the user changes directories to "pub/seismic". Waveforms of individual events for the period April 1995 through the present are accessed as Unix- compressed SAC files, through the anonymous FTP directory. A "readme"file offers further explanation about the data. Older waveform data in SAC format (1981 - March 1995) will be made available on theFTP site upon request.

For more information on matters discussed in this report or general earthquake information (reports, maps, catalogs, etc.) consult our web-sites www-erl.mit.edu/NESN and www.bc.edu:80/bc_org/avp/cas/wesobs/ or contact:

Robert Cicerone

MIT Earth Resources Lab

42 Carleton Street

Cambridge, MA 02142

Voice: 617-253-7863 / FAX: 617-253-6385 / Email: cicerone@erl.mit.edu

Prof. John Ebel

Weston Observatory

381 Concord Road

Weston, MA 02493

Voice: 617-552-8319 / FAX: 617-552-8388 / Email: ebel@bc.edu

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Explanation of Tables

Table 1: List of personnel operating the NESN

Table 2: List of Seismic and Strong Motion Stations

1. Code = station name

2. Lat = station latitude, degrees north
3. Long = station longitude, degrees west
4. Elev = station elevation in meters
5. Location = geographic location
6. Operator = network operator

Table 3: Earthquake Hypocenter List

1. Date = date event occurred, Yr (year)/Mo (month)/Dy (day)
2. Time = origin time of event, Hr (hour):Mn (minute):Sec (second)

   in UCT (Universal Coordinated Time, same as Greenwich Mean Time)
3. Lat = event location, latitude north in degrees
4. Long = event location, longitude west in degrees
5. Depth = event depth in kilometers
6. Mag = event magnitude
7. Int = event epicentral intensity
8. Location = event geographic location

Table 4: Earthquake detailed hypocenter and phase data list

Table Header: detailed hypocenter data

1. Geographic location
2. DATE = date event occurred, yr/mo/dy (year/month/day)
3. ORIGIN = event origin time (UCT) in hours, minutes, and seconds
4. LAT N = latitude north in degrees and minutes
5. LONG W = longitude west in degrees and minutes
6. DEPTH = event depth in kilometers
7. MN = Nuttli Lg phase magnitude with amplitude divided by period
8. MC = signal duration (coda) magnitude

   WES: 2.23 Log(FMP) + 0.12Log(Dist) - 2.36 (Rosario, 1979)
   MIT: 2.21 Log(FMP) - 1.7 (Chaplin *et al.*, 1980)

9. ML = local magnitude

   WES: calculated from Wood-Anderson seismograms (Ebel, 1982)
   GSC (Geological Survey of Canada): Richter Lg magnitude

10. GAP = largest azimuthal separation, in degrees, between stations
11. RMS = root mean square error of travel time residual in seconds
12. ERH = standard error of epicenter in kilometers
13. ERZ = standard error of event depth in kilometers
14. Q = solution quality of hypocenter

    A = excellent
    B = good
    C = fair
    D = poor

Table Body: earthquake phase data

1. STN = station name
2. DIST = epicentral distance in kilometers
3. AZM = azimuthal angle in degrees measured clockwise between true north and vector pointing from epicenter to station
4. Description of onset of phase arrival

   I = impulsive
   E = emergent

5. R = phase

   P = first P arrival
   S = first S arrival

6. M = first motion direction of phase arrival

   U = up or compression
   D = down or dilatation

7. K = weight of arrival

   0 = full weight (1.0)
   1 = 0.75 weight
   2 = 0.50 weight
   3 = 0.25 weight
   4 = no weight (0.0)

8. HRMN = hour and minute of phase arrival
9. SEC = second of phase arrival
10. TCAL = calculated travel time of phase in seconds
11. RES = travel time residual (error) of phase arrival
12. WT = weight of phase used in hypocentral solution
13. AMX = peak-to-peak ground motion, in millimicrons, of the maximum envelope amplitude of vertical-component signal, corrected for system response

14. PRX = period in seconds of the signal from which amplitude was measured
15. XMAG = Nuttli magnitude recorded at station
16. FMP = signal duration (coda), in seconds, measured from first P arrival
17. FMAG = coda magnitude recorded at station

Table 5: Microearthquakes and other non-locatable events

1. Date = date event occurred, Yr (year)/Mo (month)/Dy (day)
2. Sta = nearest station recording event
3. Arrival Time = phase arrival time, Hr (hour):Mn (minute):Sec (second)

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TABLE 1

WESTON OBSERVATORY PERSONNEL

Name	Network Position	voice phone	email address
John E. Ebel	Principal Investigator	617-552-8319	ebel@bc.edu
Alan Kafka	Research Seismologist	617-552-8300	kafka@bc.edu
Anastasia Macherides Moulis	Seismic Analyst	617-552-8325	weston.observatory@bc.edu
Edward Johnson	Project Engineer	617-552-8332	johnson@bc.edu
Patricia Tassia	Administrative Secretary	617-552-8311	tassia@bc.edu
W. Richard Ott, S.J.	Assistant to the Director	617-552-8335	ottwi@mail1.bc.edu
		617-552-8300	
Weston Observatory		617-552-8388 (FAX)	

MIT/ERL PERSONNEL

Name	Network Position	voice phone	email address
M. Nafi Toksöz	Principal Investigator	617-253-7852	toksoz@mit.edu
Robert Cicerone	Research Seismologist	617-253-7863	cicerone@erl.mit.edu
Heather Hooper	Seismic Analyst	617-253-6290	
Sara Brydges	Administrator	617-253-7797	sara@erl.mit.edu
		617-253-8027	
Earth Resources Lab		617-253-6385 (FAX)	

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TABLE 2

SEISMIC STATIONS OF THE NEW ENGLAND SEISMIC NETWORK

WES42.6403VT144.3317

Code	Lat	Long	Elev (m)	Location	Operator
BCX	42.3350	-71.1705	61.0	Chestnut Hill, MA	WES
BRY	41.9178	-71.5388	380.0	Smithfield, RI	WES
DNH	43.1225	-70.8948	24.0	Durham, NH	MIT
DXB	42.0610	-70.6992	8.0	Duxbury, MA	MIT
FFD	43.4702	-71.6533	131.0	Franklin Falls Dam, NH	
GLO	-70.7272	15.2	Gloucester, MA	MIT	
HNH	43.7050	-72.2860	180.0	Hanover, NH	WES
NH1	43.5473	-71.5743	402.0	Sanbornton, NH	WES
QUA2	42.2789	-72.3525	168.0	Belchertown, MA	WES
TRY	42.7311	-73.6669	131.0	Troy, NY	WES
UMM	44.7100	-67.4583	35.0	Machias, ME	WES
-7 2.7536	410.0	Waterbury, VT	WES		

WES	42.3850	-71.3220	60.0	Weston, MA	WES
WFM	42.6106	-71.4906	87.5	Westford, MA	MIT
WVL	44.5648	-69.6575	85.0	Waterville, ME	WES
YLE	41.3100	-72.9269	914.0	New Haven, CT	WES
PQI	46.6710	-68.0168	175.0	Presque Isle, ME	WES

STRONG MOTION STATIONS OF THE NEW ENGLAND SEISMIC NETWORK

Code	Lat	Long	Location	Operator
SM1	44.90	-67.25	Dennysville, ME	WES
SM2	44.49	-73.10	Essex Junction, VT	WES
SM3	41.45	-71.33	Newport, RI	WES
SM4	42.38	-71.32	Weston, MA	WES
SM5	42.66	-71.30	Lowell, MA	WES
SM6	42.30	-71.34	Natick, MA	WES
SM7	42.39	-71.54	Hudson, MA	WES
SM8	44.48	-69.61	North Vassalboro, ME	WES

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TABLE 3

EARTHQUAKE HYPOCENTER LIST

NEW ENGLAND AND ADJACENT REGIONS

October - December, 2002

Date	Time	Lat	Long	Depth	Mag	Int	Location
Yr/Mo/Dy	Hr:Mn:Sec			(km)			
2002/11/08	17:14:46.94	43.9795	-72.4910	9.73	2.2		NH, 15 MI SE OF NORTHFIELD
2002/12/25	18:25:20.52	44.5688	-73.7845	0.09	3.0		NY, 18 MI WSW OF PLATTSBURGH

* indicates Mc rather than Mn.

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TABLE 4

EARTHQUAKE PHASE DATA LIST
NEW ENGLAND AND ADJACENT REGIONS
October - December, 2002

```
 NORTHERN NY AND ADIRONDACKS
02DEC25 NY, 18 MI WSW OF PLATTSBURGH
  DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
  21225 1825 20.52 44-34.13  73-47.07    .09  3.0 3.1      90   .25   .6  1.7 B
  STN  DIST AZM  RMK HRMN    SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
  PNY  34.6  32 EP 0 1825 25.88   5.36   5.68  -.34 1.17
               S 0 1825 30.45   9.93  10.11  -.23 1.17
  BGR  54.9 302 EP 0 1825 29.37   8.85   8.82  -.02 1.13
               ES 0 1825 36.09  15.57  15.70  -.21 1.13
  MIV  58.6 160 EP 0 1825 29.92   9.40   9.37  -.02 1.12
               ES 0 1825 37.13  16.61  16.69  -.16 1.12
 FLET  68.3  75  P 0 1825 31.15  10.63  10.84  -.27 1.10
               ES 0 1825 40.13  19.61  19.30   .21 1.10
  NCB  75.1 208 EP 0 1825 32.39  11.87  11.88  -.10 1.08
               ES 0 1825 41.72  21.20  21.14  -.12 1.08
  MDV  79.5 143 EP 0 1825 33.03  12.51  12.55  -.05 1.07
               ES 0 1825 42.59  22.07  22.33  -.29 1.07
  VT1  86.1 108 EPU0 1825 34.27  13.75  13.54   .19 1.06
               S 0 1825 45.15  24.63  24.11   .49 1.06
  PTN  95.1 270 EP 0 1825 35.78  15.26  14.91   .32 1.04
               ES 0 1825 47.23  26.71  26.54   .12 1.04
```

```
 MSNY  97.7 299 EP 0 1825 35.97  15.45  15.30   .15 1.03
                ES 0 1825 47.75  27.23  27.23  -.02 1.03
 ACCN 132.0 176 EP 0 1825 41.03  20.51  20.49  -.04  .95
                ES 0 1825 57.05  36.53  36.48  -.05  .95
 LBNH 152.5 104 EP 0 1825 44.56  24.04  23.60   .38  .90
                ES 0 1825 62.46  41.94  42.01  -.17  .90
  HNH 153.7 129 IPU0 1825 44.18  23.66  23.78  -.14  .90              166  3.0
                 S 4 1825 61.69  41.17  42.33 -1.20  .00
  FFD 210.1 126 EP 0 1825 53.54  33.02  32.23   .77  .77              216  3.3
                ES 4 1825 79.08  58.56  57.37  1.16  .00
  WES 313.9 141 EPU0 1826  5.49  44.97  45.05  -.09  .54 100 .16  3.2 166  3.1
                 S 4 1826 45.72  85.20  80.20  4.99  .00
  BCX 326.0 140 EP 0 1826   .00  39.48  46.55   .00  .00  91 .15  3.2
                ES 4 1826 49.41  88.89  82.85  5.99  .00
  WVL 327.5  91 EP 0 1826  7.20  46.68  46.74  -.06  .51  47 .23  2.7
                 S 4 1826 49.49  88.97  83.19  5.77  .00
  BRY 346.5 148 EP 0 1826   .00  39.48  49.07   .00  .00  86 .17  3.2
                ES 4 1826 43.15  82.63  87.35 -4.83  .00
  UMM 502.5  88 EP   1826 28.05  67.53  68.34  -.82  .00  18 .17  3.0
                ES 4 1826 95.52 135.00 121.65 13.34  .00
SOUTHEAST MAINE CRUSTAL MODEL
02NOV08 NH, 15 MI SE OF NORTHFIELD
  DATE     ORIGIN    LAT N    LONG W   DEPTH   MN  MC  ML GAP   RMS  ERH  ERZ Q
  21108 1714 46.94 43-58.77  72-29.46   9.73  2.2  .0     121   .34  1.4 12.0 C
  STN  DIST AZM  RMK HRMN   SEC   TOBS   TCAL   RES   WT AMX PRX XMAG FMP FMAG
  HNH  34.7 152  P C 1714 53.11   6.17   5.85   .29 1.11 191 .34  2.0
                 S   1714 57.41  10.47  10.41   .00 1.12
 LBNH  53.7  57  P   1714 56.21   9.27   8.83   .38  .00
                 S   1714 62.91  15.97  15.72   .14 1.08
  MDV  55.4 272  P   1714 56.66   9.72   9.10   .60  .00
                 S   1714 62.96  16.02  16.20  -.21 1.08
 HBVT  62.6 313  P   1714 57.84  10.90  10.23   .61  .00
                 S   1714 64.99  18.05  18.21  -.26 1.05
  MIV  84.0 277  P   1714 61.20  14.26  13.62   .59  .00
                 S   1714 71.48  24.54  24.24   .21 1.01
  FFD  88.1 130 EP C 1714 61.76  14.82  14.27   .53  .92 136 .22  2.3
                 S   1714 71.48  24.54  25.40  -.90  .63
 FLET  90.4 336  S   1714 72.98  26.04  26.04  -.11 1.00
```

TABLE 5

MICROEARTHQUAKES AND OTHER NON-LOCATABLE EVENTS

Date	Sta	Arrival Time
Yr/Mo/Dy		Hr:Mn:Sec

None recorded this period.

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NESN Station Map

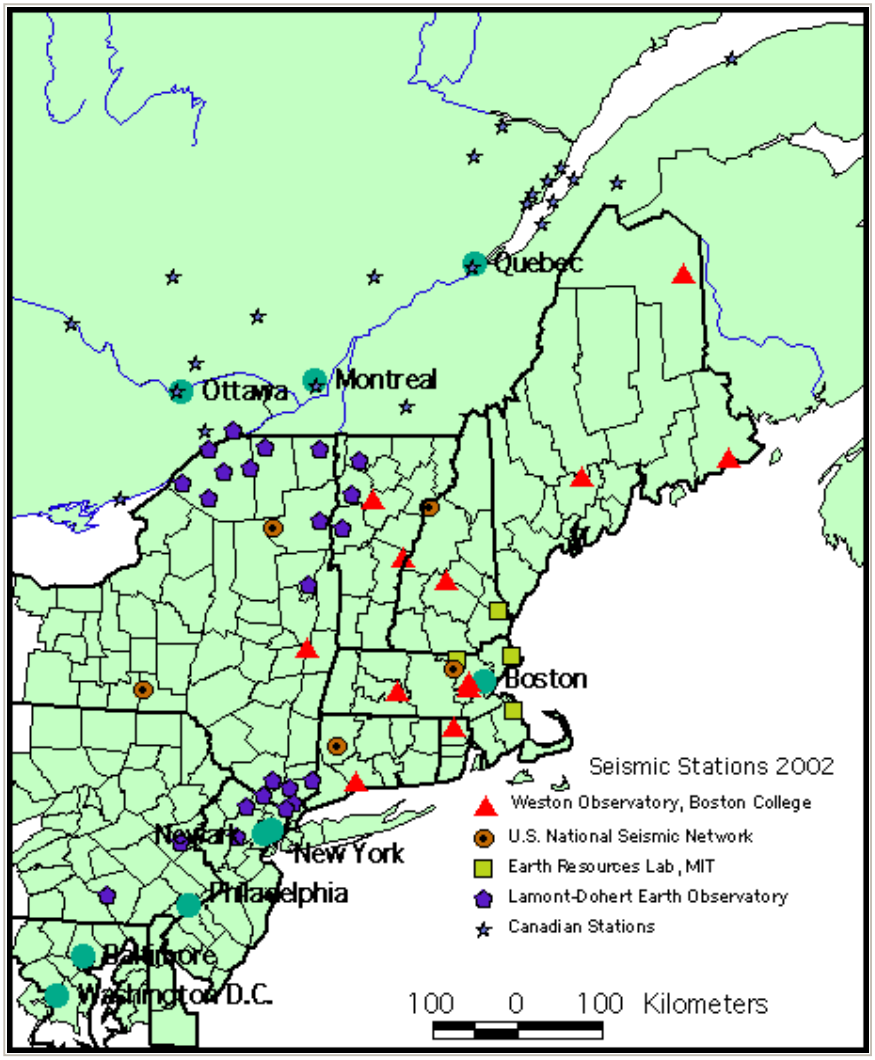

Figure 1: Map of stations of the New England Seismic Network (NESN) in operation during period October - December, 2002. Also included are the US National Seismic Network stations operating in New England during this period.

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NESN Strong-Motion Station Map

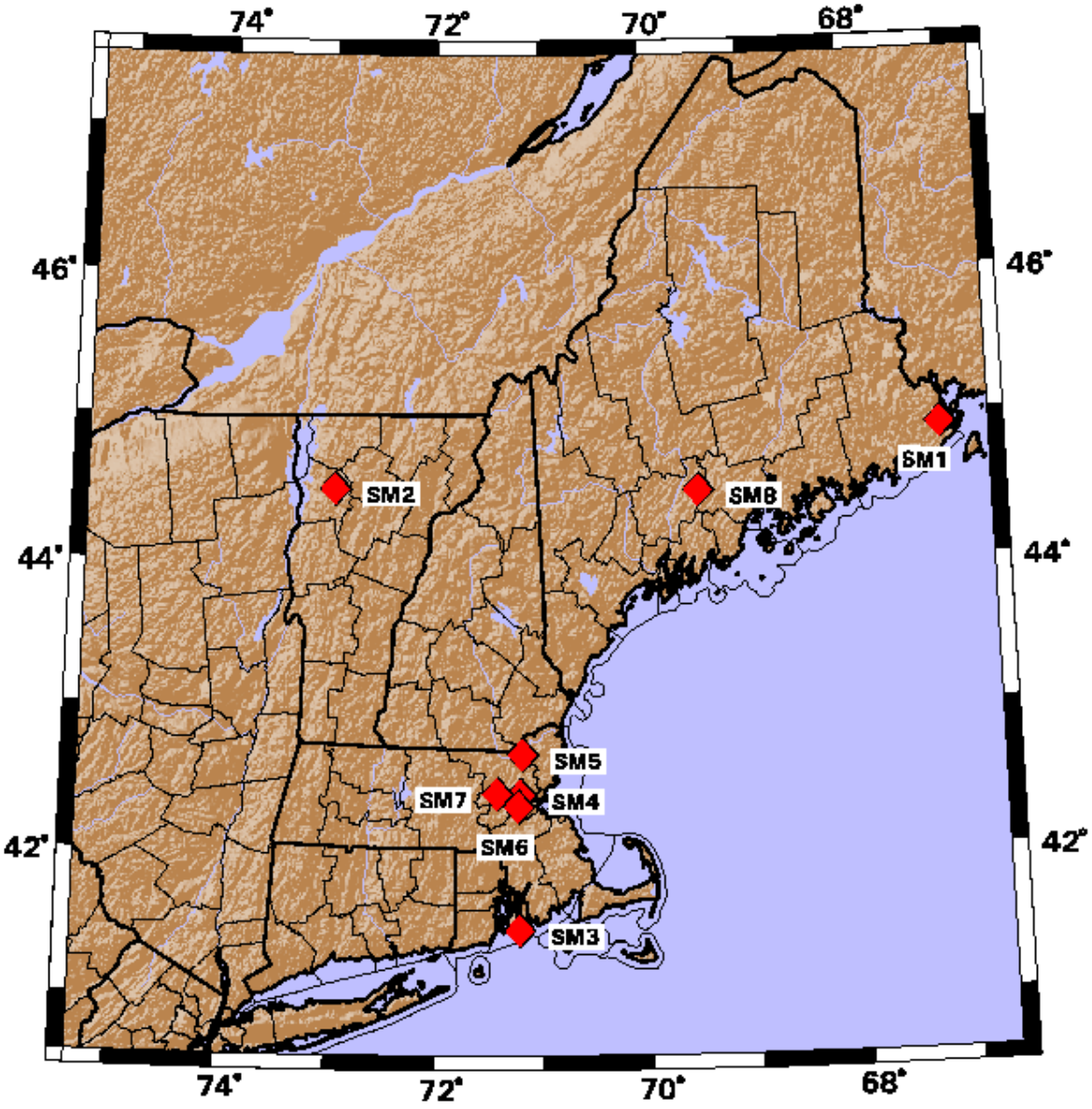

Figure 2: Map of strong-motion stations of the New England Seismic Network (NESN) in operation during period October - December, 2002.

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NESN Quarterly Seismicity Map

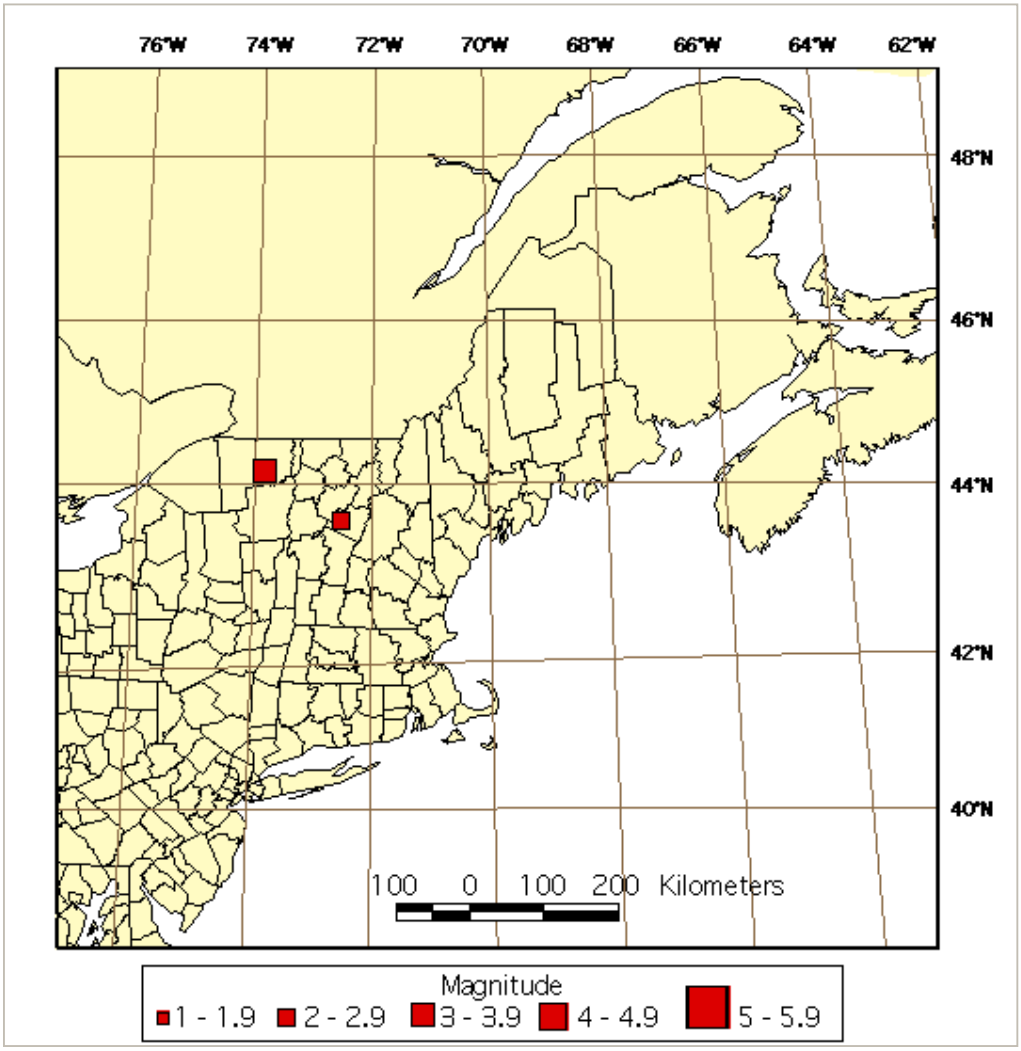

Figure 3: Earthquake epicenters located by the NESN during period October - December, 2002.

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NESN Cumulative Seismicity Map

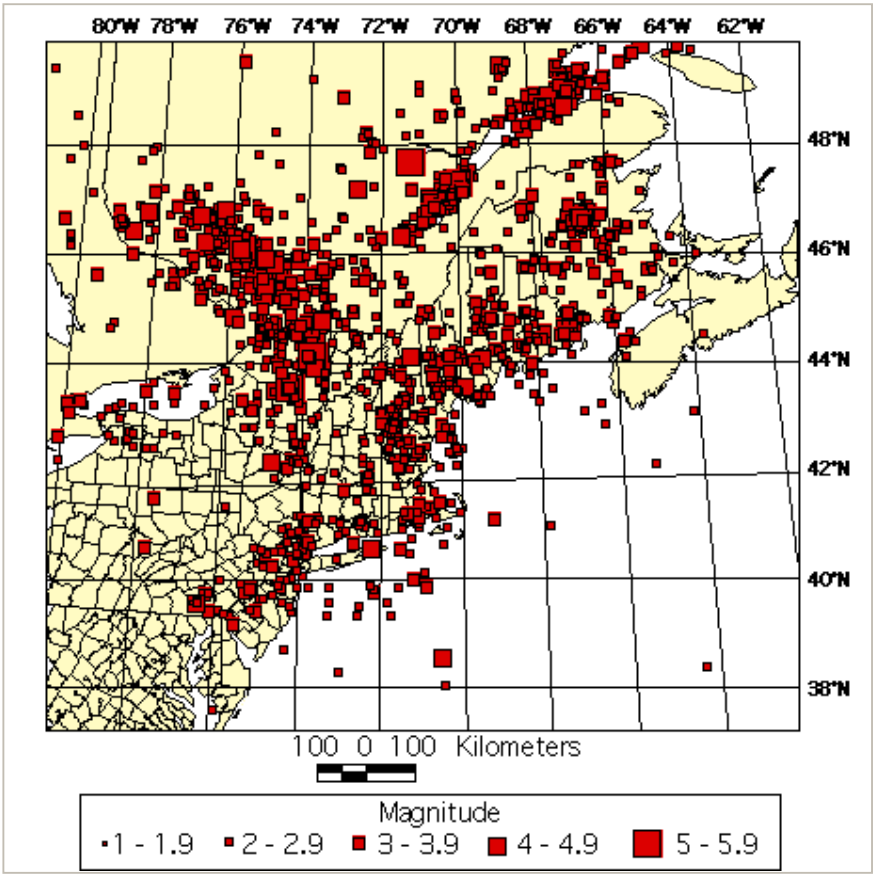

Figure 4: Seismicity for period October, 1975 - December, 2002.

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Acknowledgments

We would like to thank the Undergraduate Research Opportunities Program (UROP) of MIT for its support to the network. Our map database has been developed in-house using ARCINFO and in part basemap data provided by ESRI, Inc. (Arcdata Online), USGS GTOPO30 Elevation Data, and TIGER/Line '94, '95, and '97 (US Census Bureau) spatial data.

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